

## CLAIMS

We claim:

1. A vertical cavity surface-emitting laser comprising:  
2 a device structure, having a height  $z$  and an aperture, including  
3 an active layer having an upper and lower surface, and  
4 upper and lower distributed Bragg reflectors on the upper and lower  
5 surfaces of the active layer and adjacent thereto;  
6 contacts for applying a voltage across the active region; and  
7 a light emission property that varies within the aperture and the light output is in  
8 spatially fixed modes.

1. 2. A vertical cavity surface-emitting laser, as defined in claim 1, wherein the light  
2 emission property is the Fabry-Perot wavelength.

1. 3. A vertical cavity surface-emitting laser, as defined in claim 1, further  
2 comprising a non-planar layer within the device structure, positioned at height  $x$ , where  
3  $0 \leq x < z$ , between heights  $x$  and  $z$ , the light emission property is a refractive index that  
4 varies in the plane perpendicular to the light output.

1. 4. A vertical cavity surface-emitting laser, as defined in claim 3, wherein the  
2 refractive index has a lengthscale on the order of the lasing wavelength.

1. 5. A vertical cavity surface-emitting laser, as defined in claim 3, further  
2 comprising a substrate having a first side adjacent to the lower distributed Bragg  
3 reflector.

1. 6. A vertical cavity surface-emitting laser, as defined in claim 5, further including  
2 a texturing layer interposing the substrate and the device structure, wherein the non-  
3 planar layer is the texturing layer.

*Mark 1*  
1. A vertical cavity surface-emitting laser, as defined in claim 6, wherein the texturing layer is patterned.

1. 8. A vertical cavity surface-emitting laser, as defined in claim 5, wherein the non-  
2 planar layer is a layer within at least one of the upper and lower distributed Bragg  
3 reflectors.

1. 9. A vertical cavity surface-emitting laser, as defined in claim 5, wherein the  
2 layer within at least one of the upper and lower distributed Bragg reflectors is patterned.

1. 10. A vertical cavity surface-emitting laser, as defined in claim 5, wherein non-  
2 planar layer is a first surface of the substrate adjacent the lower Bragg reflector.

1. 11. A vertical cavity surface-emitting laser, as defined in claim 10, wherein the  
2 first surface is patterned.

*Sub a2*  
1. 12. A vertical cavity surface-emitting laser, as defined in claim 3, wherein the  
2 non-planar layer introduces a phase mismatch in the device structure.

*Mark 1*  
1. 13. A vertical cavity surface-emitting laser, as defined in claim 12, wherein the  
2 non-planar layer is a layer within at least one of the upper and lower distributed Bragg  
3 reflectors.

1. 14. A vertical cavity surface-emitting laser, as defined in claim 13, wherein the  
2 layer within at least one of the upper and lower distributed Bragg reflectors is patterned.

*Sub a3*  
1. 15. A vertical cavity surface-emitting laser, as defined in claim 3, further  
2 comprising a planarizing plane within the device structure, positioned at height  $y$ , where  
3  $x < y < z$ .

*Mark 1*  
1. 16. A vertical cavity surface-emitting laser, as defined in claim 15, between  
2 heights  $x$  and  $y$ , the refractive index varies in the plane perpendicular to the light output.

*and c'*  
1 17. A vertical cavity surface-emitting laser, as defined in claim 15, wherein the  
2 refractive index has a lengthscale on the order of the lasing wavelength.

1 18. A vertical cavity surface-emitting laser, as defined in claim 15, further  
2 comprising a substrate having a first surface adjacent to the lower distributed Bragg  
3 reflector.

1 19. A vertical cavity surface-emitting laser, as defined in claim 18, further  
2 including a texturing layer interposing the substrate and the device structure, wherein the  
3 non-planar layer is the texturing layer.

1 20. A vertical cavity surface-emitting laser, as defined in claim 19, wherein the  
2 texturing layer is patterned.

1 21. A vertical cavity surface-emitting laser, as defined in claim 19, wherein the  
2 non-planar layer is a layer within at least one of the upper and lower distributed Bragg  
3 reflectors.

1 22. A vertical cavity surface-emitting laser, as defined in claim 18, wherein the  
2 layer within at least one of the upper and lower distributed Bragg reflectors is patterned.

1 23. A vertical cavity surface-emitting laser, as defined in claim 18, wherein non-  
2 planar layer is a first surface of the substrate adjacent the lower Bragg reflector.

1 24. A vertical cavity surface-emitting laser, as defined in claim 23, wherein the  
2 first surface is patterned.

1 25. A vertical cavity surface-emitting laser, as defined in claim 15, wherein the  
2 non-planar layer introduces a phase mismatch in the device structure.

1                    26. A vertical cavity surface-emitting laser, as defined in claim 25, wherein the  
2                    non-planar layer is a layer within at least one of the upper and lower distributed Bragg  
3                    reflectors.

1                    27. A vertical cavity surface-emitting laser, as defined in claim 25, wherein the  
2                    layer within at least one of the upper and lower distributed Bragg reflectors is patterned.

1                    28. A method for manufacturing a vertical cavity surface emitting laser  
2                    comprising the steps of:

3                    preparing a substrate such that there is a texturing layer;

4                    depositing a lower distributed Bragg reflector;

5                    depositing an active layer;

6                    depositing an upper distributed Bragg reflector; and

7                    fabricating electrical contacts for applying a voltage across the active layer.

1                    29. A method for manufacturing a vertical cavity surface emitting laser, as  
2                    defined in claim 28, further comprising the step of removing the substrate after the step of  
3                    fabricating electrical contacts.

1                    30. A method for manufacturing a vertical cavity surface emitting laser  
2                    comprising the steps of:

3                    depositing a lower distributed Bragg reflector having a texturing layer;

4                    depositing an active layer;

5                    depositing an upper distributed Bragg reflector; and

6                    fabricating electrical contacts for applying a voltage across the active layer.

1                    31. A method for manufacturing a vertical cavity surface emitting layer  
2                    comprising the steps of:

3                    depositing a lower distributed Bragg reflector;

4                    depositing an active layer having a texturing layer;

5                    depositing an upper distributed Bragg reflector; and

6                    fabricating electrical contacts for applying a voltage across the active layer.

1        32. A method for manufacturing a vertical cavity surface emitting layer  
2 comprising the steps of:  
3        depositing a lower distributed Bragg reflector;  
4        depositing an active layer;  
5        depositing an upper distributed Bragg reflector having a texturing layer; and  
6        fabricating electrical contacts for applying a voltage across the active layer.

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